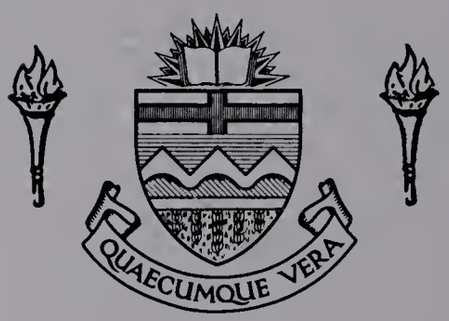

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IDENTIFYING READING PROBLEMS USING THE WISC

by

DOROTHY JEAN CLANDININ

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN

PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF EDUCATION

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA

FALL, 1974

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Identifying Reading Problems Using the WISC" submitted by DOROTHY JEAN CLANDININ in partial fulfilment of the requirements for the degree of Master of Education.

Date. Aug.

ABSTRACT

To determine whether the Wechsler Intelligence Scale for Children can discriminate reading ability, sixty-six Grade 2 and 3 boys were selected from the total Grade 2 and 3 male population in two Edmonton, Alberta, elementary schools. On the basis of two subtests of the Stanford Achievement reading Test the subjects were classified into three groups of reading ability: severely disabled, mildly disabled, and achieving. Each student was administered the Wechsler Intelligence Scale for Children. On the basis of these scores, a series of decision rules employing an interaction effect between the subtest scaled scores on the *Information*, *Arithmetic*, *Similarities*, *Picture Completion*, and *Coding* subtests were formulated. An independent sample was selected and on the basis of the decision rules and individual results of the WISC, each subject was classified into one of the three reading groups.

It was concluded that the decision rules applied to each individual's WISC results do discriminate between reading abilities.

ACKNOWLEDGEMENTS

I sincerely wish to thank Dr. B. Corman for his assistance, encouragement and help in the preparation of this thesis.

To my husband Tom and son Tommy, whose constant encouragement expectations and patience never failed me, I am most sincerely grateful. I would also like to thank Mrs. Ruth Clandinin for her help and patience while I worked on this thesis.

I would also like to thank the staff and students at the two schools I worked at for their help in the preparation of this thesis.

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CHAPTER I

BACKGROUND TO THE STUDY

Introduction

A provincial grant to the Edmonton Public School System in 1973 under the Educational Opportunity Fund is providing a resource room teacher in many elementary schools. This teacher's function is to remediate the reading disabilities of students in Grades One through Four. This program is designed to allow regular classroom teachers to refer children for resource room instruction. Teachers refer students who, in their estimation read below their expected grade level and who would therefore presumably benefit from remedial reading instruction. The teachers have Stanford Achievement Test (Kelly, Madden, Gardner and Rudman, 1965) reading scores available from cumulative record cards for each student. The Stanford Achievement Test is administered routinely to all elementary school students in the Edmonton Public School System in June of each year. This test is a group achievement test which measures reading and other skills. The parts of the Stanford Achievement Test which are recorded are those scores which pertain to reading. The results of this test are computer analyzed and returned for each student with performance indicated by percentiles based on Edmonton Public School norms. While there is, of course, test error in the results of any group tests, these results often confirm the teacher's estimation of an individual's reading ability. However, many students move into the system throughout each year with

little or no test information pertaining to their reading skills. For these students and for students for whom the Stanford Achievement Test score does not appear to the teacher to be valid, referral for special help is based solely on teacher judgement.

Students are sometimes referred for resource room help when their reading test scores and teacher estimation of reading ability are both below expected grade level and who, in fact, have social and emotional problems which mask their true reading ability. On the other hand, students are sometimes referred for counselling who clearly need the remedial reading provided by the resource teacher. For example, students who have a large sight word vocabulary but poor reading comprehension skills sometimes become behavioral problems in the classroom and because of these behavioral concerns teachers refer these students for counselling when a resource room referral would be appropriate. For all these reasons a further screening for reading ability is required.

Students referred for resource room help are simultaneously referred to the school counsellor or psychologist for further testing to determine appropriate help. The guidelines of the project funding specify that each student receiving resource room help must first be screened using an individual psychological test such as the Wechsler Intelligence Scale for Children (Wechsler, 1949). In Edmonton the WISC* is used almost exclusively for screening these children. Psychometric rating as determined by the WISC must place the child in the average range of intellectual ability, that is, a full scale I.Q. of 90

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*WISC equivalent to Wechsler Intelligence Scale for Children.

or above, to qualify him for resource room help.

The purpose of giving the WISC is to determine whether the student's I.Q. qualifies him for resource room help. However there is a limit on the help available from resource room teachers and it becomes necessary to use the WISC intuitively to make a further distinction among students needing help. There is some research in the use of the WISC for this purpose (reviewed below). The WISC Manual offers no reliable evidence that the WISC can be used to discriminate disabled readers. In actual practice the author has found some intuitive relationships between subtest scores and reading ability. If data can be found to support the hypothesis that the WISC can discriminate between achieving, mildly disabled and severely disabled readers, the refinement of a procedure would more effectively implement the placement of students in the resource room and would further facilitate the appropriate referral of students to a remedial reading specialist for further testing and diagnosis. If, further, it can be demonstrated that it is possible to discriminate the severely disabled readers from less disabled readers, this will ensure that students most seriously in need of resource room help will receive priority. With these objectives in view, the present study was initiated.

Literature Review

The significance of subtest patterns of scores for the WISC has been widely investigated with particular interest in its relationship to the development of reading skills. Previous investigators have attempted to analyse WISC subtest patterns in the diagnosis of reading

problems and to assess more accurately intellectual functioning with regard to reading skills (Graham, 1952; Burks and Bruce, 1955; Altus, 1956; Hirst, 1960; Kallos, Grabow and Guarino, 1961; Neville, 1961; Robeck, 1964; Sawyer, 1965; Reid and Schoer, 1966; Silverberg and Feldt, 1968; Ackerman, Peters and Dykman, 1971; Hunter and Johnson, 1971). Additionally, reading specialists have traditionally viewed the WISC as a significant test instrument in diagnosing reading problems (Kender, 1972). These studies have attempted to establish patterns of mental abilities which characterize poor reading skills. Using analyses of the WISC subtest scores, some authors report common characteristics of the WISC profile among poor readers.

However on the basis of the studies reporting significant diagnostic patterns, it is difficult to make any meaningful generalizations regarding a specific WISC profile for poor readers because of the different criteria used to identify poor readers, the various statistical treatments employed to analyse the data, the small and often self-selected groups that were studied and the failure of many studies to employ a control group of subjects. These criticisms will be discussed in detail (pp 8-10).

However basic methodological considerations aside, different investigators have made different claims for WISC subtests as predictors of "good" and "poor" readers. For example, some studies have suggested that poor readers may be significantly, but not always statistically, low on the *Arithmetic* and *Coding* subtests (Hurst and Portenier, 1951; Graham, 1952; Bjorn, 1955; Burks and Bruce, 1955; Altus, 1956; Spache, 1957; Hirst, 1960; Kallos, Grabow and Guarino, 1961; Robeck, 1964; Hunter and Johnson, 1971). However Altus (1956)

asserted that *Coding* and *Arithmetic* subtest scores are significantly lower than *Vocabulary*, *Digit Span*, *Picture Completion*, *Object Assembly* and *Picture Arrangement* subtest scores for poor readers. Other research has supported the observation that poor readers score significantly lower on the *Arithmetic* subtest than achieving readers but have not assigned diagnostic value to the *Coding* subtest scores (Neville, 1961; Reid and Schoer, 1966).

A poor performance of students with reading problems on the *Digit Span* subtest has been reported by several authors (Hirst, 1960; Neville, 1961; Robeck, 1964; Reid and Schoer, 1966; Hunter and Johnson, 1971).

Studies also indicated a high performance of students with reading problems on the *Picture Completion* subtest in relation to other subtest scores (Bjorn, 1955; Altus, 1956; Spache, 1957; Hirst, 1960; Robeck, 1964; Reid and Schoer, 1966).

Burks and Bruce (1955) noted a high performance of students with reading problems on the *Picture Arrangement*, *Block Design* and *Comprehension* subtests relative to other subtest scores. Other studies supported the diagnostic value of these subtests but not necessarily in the combination that Burks and Bruce required. A higher score on the *Picture Arrangement* subtest relative to other subtest scores was reported for children with reading difficulties (Altus, 1956; Hirst, 1960; Neville, 1961). There was similarly some support for the observation that children with reading difficulties score higher on the *Block Design* subtest (Kallos, Grabow and Guarino, 1961; Neville, 1961; Robeck, 1964). Robeck (1964) also reported a higher score on the *Comprehension* subtest.

Reid and Schoer (1966) and Hunter and Johnson (1971) report a poor

performance of students with reading problems on the *Similarities* subtest. These results contradict several studies which predicted that poor readers should score high on the WISC *Similarities* subtest (Hurst and Portenier, 1951; Graham, 1952; Burks and Bruce, 1955; Spache, 1957; Robeck, 1964). Finally, Silverberg and Feldt (1968) recently suggested that the *Similarities* subtest is not useful in identifying students with reading problems.

Several reports noted a poor performance of students with reading problems on the *Information* subtest (Burks and Bruce, 1955; Altus, 1956; Kallos, Grabow and Guarino, 1961; Neville, 1961; Robeck, 1964; Hunter and Johnson, 1971).

Two recent studies have also suggested that analyses among the ten WISC subtests provide no clues as to the nature or extent of a reading disability (Silverberg and Feldt, 1968; Ackerman, Peters and Dykman, 1971).

Clearly one can find both positive and negative evidence in the literature for the value of almost any WISC subtest for predicting reading disability.

While the use of WISC subtests (either separately or in combination) as reading level indicators is questionable, there has been more support for the use of the WISC performance partial score. There is substantial support for the observation that pupils with apparent reading problems do obtain a higher WISC performance I.Q. than WISC verbal I.Q. (Neville, 1961; Ackerman, Peters and Dykman, 1971; Hunter and Johnson, 1971). However this difference too was not always found to be significant (Altus, 1956; Hirst, 1960; Kallos, Grabow and Guarino, 1961; Silverberg and Feldt, 1968).

Although some of the studies have not considered theoretical concerns, many researchers have attempted to explain their findings using a theoretical framework. Thus Graham (1952) observed that poor readers achieved significantly lower scores on *Arithmetic*, *Vocabulary* and *Coding* subtests. He consequently theorized that poor readers had the greatest difficulty with subtests which resemble most closely school and reading type situations. Burks and Bruce (1955) hypothesized, on similar observations, that poor readers approach learning in a more concrete manner because they are relatively unable to handle abstractions. These authors therefore concluded that poor readers are at a disadvantage because learning to read consists of abstractions dependent upon memory functions. Neville (1961) similarily hypothesized that poor readers seemed to have most difficulty in those subtests closely resembling school-type situations and tasks associated with concentrating. Poor readers do best on subtests clearly removed from verbal skills and activities divorced from school tasks. Neville (1961) further states that "excellent performance on the *Picture Arrangement* subtest results from long practice at using pictures as clues to the context of the printed page which they are unable to read." (Neville, 1961, p. 197). Robeck (1964) contended that children with reading problems scored high in subtest areas that involve judgement and ability to generalize and relatively low on tasks that involved the ability to recall specific verbal materials. Robeck (1964) felt poor readers could work more effectively with "figural" (concrete) rather than with "symbolic" (abstract) materials on performance tasks. Kallos, Grabow and Guarino (1961) hypothesized that retarded development of visual-motor skills such as those involved in *Coding*, may be a primary

cause of reading disabilities. The authors suggest that relatively low *Information* and *Arithmetic* scores may reflect variables in the home and school environment which promote reading disability.

Underlying this discussion is the idea that poor readers have difficulty with basic psychological processes which interfere with the abilities to concentrate, to deal with abstract material and to recall information and detail. Consequently these children have more difficulty in dealing with school tasks such as reading.

Due to problems of experimental and statistical design, the results of many of the studies reviewed above must be interpreted with caution and in some cases the implications are not clear when extrapolated to normal populations of primary school children. Among such problems in experimental design and interpretation are:

1) *the source of subjects*

In some studies subjects used were referred for other learning difficulties or for behavioral problems not necessarily associated with reading difficulties. Ackerman, Peters, and Dykman (1971) used as disabled readers students who had been referred as learning disabled students to a special child study center by their parents or by the school. Silverberg and Feldt (1968) used only children who were referred for psychological evaluation. Kallos, Grabow and Guarino (1961) used students who were selected from children seen at a University reading centre. Altus (1956) analyzed the results of children referred to a guidance centre by their teachers because of severe academic difficulties. Detailed analyzes of these data are therefore complicated by such factors as: the presence of children with other learning disabilities, *e.g.* dysgraphia; the use of only children who are referred

rather than a more representative sampling; and by using the carefully selected population of students seen at a University reading centre.

2) *the small sample sizes and different age ranges of subjects*

In one study conclusions were drawn on the basis of a sample of twenty-five pupils whose grade placement extended from grades three to eight (Altus, 1956). Burks and Bruce (1955) drew comparisons on the basis of thirty-one poor readers and eleven good readers whose grade placement extended from grades three to eight. Hirst (1960) used only thirty remedial readers whose chronological ages ranged from 8-0 to 13-6. Kallos, Grabow and Guarino (1961) included thirty-seven boys whose age range was from 9-0 to 14-0. Detailed analyzes of these data are complicated by the large chronological age spread of subjects used which would increase the liklihood of finding significant differences between WISC subtests but which would not be practical for use in predicting how an individual student would perform relative to his own age group. In addition Cohen (1959) found different factorial structures which appear in the WISC at upper and lower age limits and this different functioning would further prevent the discovery of significant relationships.

3) *the different definitions of reading competence used*

Sawyer (1965) interpreted reading as including both word recognition and comprehension. This interpretation was also used by Silverberg and Feldt (1968). However Kallos, Grabow and Guarino (1961) used a measure of word recognition only as did Ackerman, Peters and Dykman (1971). The studies discussed also varied in using silent and oral reading tests to measure reading disabilities. To provide a useful measure of reading level it is important to include both word

recognition and comprehension. It is possible for students to score at or near grade level in word recognition skills but have great difficulty in comprehending what they have read. Studies which use only a measure of word recognition as a reading level indicator have not included these disabled readers in their studies.

4) *the lack of control groups for comparison*

In some studies one or two groups of poor readers were tested but no control group of achieving readers was employed to form a basis of comparison (Altus, 1956; Hirst, 1960; Graham, 1952; Kallos, Grabow, and Guarino, 1961; Robeck, 1964; Sawyer, 1965).

It must therefore be concluded that among this myriad of often contradictory use of research methods, summarized in Table 1, no clear evidence for WISC subtest profiles which will identify poor readers has yet been established nor has the possibility of discovering such profiles been ruled out.

TABLE 1. Summary of Reported Relationships Between the WISC and Reading Ability

Study	N	Sample Description	Subtest Scores for Poor Readers										
			Information	*Comprehension*	*Arithmetic*	*Similarities*	*Vocabulary*	*Digit Span*	*Picture Competion*	*Picture Arrangement*	*Block Design*	*Object Assembly*	*Coding*
Graham	31	Poor readers only	N.D.	N.D.	Low	High	Low	Low	N.D.	N.D.	N.D.	N.D.	Low
Burksand Bruce	42	11 good readers, 31 poor readers Grades 3-8	Low	High	Low	High	N.D.	N.D.	N.D.	High	High	N.D.	Low
Altus	25	Poor readers only, Grades 3-8	Low	N.D.	Low	N.D.	High	High	High	High	N.D.	High	Low
Hirst	30	Poor readers only, C.A. 8-0 - 13.6	N.D.	N.D.	Low	N.D.	Low	Low	High	High	High	High	Low
Neville	70	35 good readers, 35 poor readers Boys only	Low	N.D.	Low	N.D.	N.D.	Low	N.D.	High	High	N.D.	N.D.
Kallos, Grabow and Guarino	37	Poor readers only, Boys only, C.A. 9-0 - 14-0	Low	N.D.	Low	N.D.	N.D.	N/A	N.D.	N.D.	High	N.D.	Low
Robeck	80	Poor readers only, C.A. 6-10 - 13-9	Low	High	Low	High	High	Low	High	N.D.	High	N.D.	Low
Sawyer	180	Poor readers only, C.A. 8-0 - 15-5	Does not lend itself to classification in this manner										
Reid and Schoer	87	3 groups, Boys only, 4th Grade	N.D.	N.D.	Low	Low	N.D.	Low	High	N.D.	N.D.	N.D.	N.D.
Silverberg and Feldt	146	Good and poor readers, Grades 1-3	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Ackerman, Peters & Dykman	116	82 Learning Disabled, 34 Control Boys only, C.A. 8-0 - 11-11	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Hunter and Johnson	40	20 Poor readers, 20 Control Boys only, C.A. 7-11 - 11-4	Low	N.D.	Low	Low	Low	Low	N.D.	N.D.	N.D.	N.D.	Low

N.D. - No difference found

N/A - subtest not used

CHAPTER II

METHODS FOR THE PILOT STUDY

Introduction

To summarize the discussion to this point, then, the WISC is widely used as an initial screening device for children referred to psychologists and counselors. The primary advantage of results obtained from the WISC is in determining the level of intellectual ability. However, many of the subtest scores appear to provide valuable information for the diagnosis of a variety of skills including reading. Individuals trained to administer the WISC use only an intuitive system to determine the severity of a reading disability. The need for an objective method is apparent. What follows in this chapter is a detailed description of studies that are intended to provide just such objective methods.

Sample

A sample of 66 boys was chosen by a method of systematic selection from a total population of 132 Grade 2 and 3 boys in two schools of the Edmonton Public School System. These schools are situated in what the investigator considered to be upper lower to middle middle class socio-economic areas. These schools were chosen because of their availability and, in a related study, socioeconomic status has been shown to be unrelated to the problem under investigation (Reid and Schoer, 1966). Systematic sampling was done by selecting from an alphabetical listing within each grade level every second boy from the total school

list of Grade 2 and 3 boys in each of the two schools. Only boys were selected because researchers have shown that a greater number of boys are referred for the investigation of reading disabilities (*cf.* Bentzen, 1963). Grade 2 and 3 boys were selected because it is at this age that remediation of reading difficulties is most effective (Kenney and Keeney, 1972). Additionally focusing on second and third grade students narrowed the chronological age range, a confounding factor discussed earlier.

Tests Applied

Independent Variable. Two subtests of the Stanford Achievement Test were used as a basis for dividing the readers into three categories of reading ability: severely disabled readers, mildly disabled readers and achieving readers. The Stanford Achievement Test is a widely used standardized test and validity and reliability coefficients are given in the test manuals and in Buros' Mental Measurements Yearbook (1972). The two subtests of the Stanford Achievement Test used were Word Reading and Paragraph Meaning on the Primary I Battery administered to Grade 2 students and Word Meaning and Paragraph Meaning on the Primary II Battery administered to Grade 3 students. The two areas tested provide a measure of both word reading ability and the ability to comprehend connected discourse. Both of these areas are equally important in measuring a child's true reading ability. Focusing on both facets of reading skills eliminated the narrowness of other studies as discussed earlier. The Word Study Skills subtest was not included because, while this subtest does provide valuable diagnostic teaching information, the skills measured by it are subsumed by the other two subtests.

The norms used were Edmonton norms as determined by the Research Department of the Edmonton Public School Board. The scores were reported in the cumulative record for each student in percentiles. The norming was done independently for each grade level. While the test batteries measure the same skill areas at each grade level, there are somewhat different number of test items in the subtests at the Grade 2 and 3 levels.

The median score for each student's two subtests was computed. The Kendall rank correlation coefficient r(tau) between the two subtests provided a r of .56 which indicates a positive correlation between the subtests, justifying the averaging of these two subtests.

The three reading categories were defined as follows:

1) Severely disabled readers were those readers achieving a median percentile score below the 25th percentile.
2) Mildly disabled readers were those readers achieving a median score below the 50th percentile and above and including the 25th percentile.
3) Achieving readers were those readers achieving a median score above and including the 50th percentile.

The sample (N=66) was classified into three groups based on reading skill: severely disabled readers, mildly disabled readers and achieving readers. Using the decisions described above, these three categories included 14 severely disabled readers, 21 mildly disabled readers, and 31 achieving readers.

Dependent Variables. The WISC was the dependent test measure employed. Five Verbal and five Performance subtests were administered

to each subject. The supplemental *Digit Span* subtest in the Verbal and *Mazes* subtest in the Performance section of the test were omitted because of the time available for testing and because of the relatively low correlation of these two subtests with other subtests of the scale (Wechsler, 1949).

The scaled scores for each subtest of the WISC were used in the analyses. These scores were derived to provide a mean scaled score of 10 and a standard deviation of 3 at each age and for each of the separate tests (Wechsler, 1949).

CHAPTER III

RESULTS OF THE PILOT STUDY

The Data

Of the total experimental group (N=66) included in the pilot study the mean age is 97.1 months and the mean grade level is 2.5, with a median score of 47.5 on the two Stanford Achievement subtests employed (Table 2). The mean WISC full scale I.Q. is 108 with a mean verbal scale I.Q. of 106 and a mean performance scale I.Q. of 110. From these results it is reasonable to assume that the experimental sample did not differ significantly from the normal population of Edmonton Grade 2 and 3 boys. The median reading score is somewhat below the 50th percentile but, as the present study includes only boys, the somewhat lower score would be expected (McCarthey, 1954). The mean full scale I.Q. and the mean Verbal scale I.Q. are almost one standard deviation above the mean for the U.S. National norms. The mean performance scale I.Q. is significantly greater. But in general, Edmonton students exceed the U.S. norms on the WISC scales*

A description by reading group categories is summarized in Table 3. It is evident that there is no practical difference between the mean age or the mean grade level of the three groups. The mean verbal scale I.Q. of the achieving group is significantly higher than the mean verbal scale I.Q.'s of the mildly and severely disabled groups. (The

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*Personal communication from Dr. J. Patterson, Professor of Educational Psychology, University of Alberta.

TABLE 2. Mean Age, Grade, WISC I.Q.'s and Median Reading Scores of the Pilot Sample

	$\bar{x}$	S
Age (months)	97.1	8.7
Grade	2.5	0.5
WISC I.Q.'s[a]		
Full Scale I.Q.	108.3	10.1
Verbal Scale I.Q.	105.7	10.8
Performance Scale I.Q.	110.2	11.0
	Median	Interquartile Range
Reading Score[b]		
Word Meaning	47.5	25.3
Paragraph Meaning	53.5	23.3
Median Score	47.5	20.3

[a]WISC scores have a mean of 100 and a S of 10 (Wechsler, 1949).

[b]Reading scores are given as percentile scores determined using norms of the Edmonton Public School Board, Research Department and Instruction.

TABLE 3. Mean Age, Grade, WISC I.Q.'s and Median Reading Scores of the Severely Disabled, Mildly Disabled and Achieving Readers of the Pilot Sample

		Severely Disabled N = 14		Mildly Disabled N = 21		Achieving Readers N = 31	
		$\bar{x}$	S	$\bar{x}$	S	$\bar{x}$	S
Age		94.7	6.4	98.5	8.7	94.3	6.4
Grade		2.5	0.5	2.6	0.5	2.5	0.5
WISC:	Full Scale I.Q.[a]	106.7	10.4	106.3	11.3	110.9	8.2
	Verbal Scale I.Q.	102.5	9.9	102.9	12.2	109.0	8.8
	Performance Scale I.Q.	109.7	12.9	109.0	11.8	111.0	10.0
		Median	Inter-quartile Range	Median	Inter-quartile Range	Median	Inter-quartile Range
Reading Score:[b]	Word Meaning	9.5	4.8	34.0	12.0	74.0	10.8
	Paragraph Meaning	6.5	4.3	42.0	8.1	73.0	11.5
	Median Score	9.0	4.3	37.0	2.3	71.0	7.9

[a]WISC scores have a mean of 100 and a S of 10 (Wechsler, 1949).

[b]Reading scores are given as percentile scores determined using norms of the Edmonton Public School Board, Research Department and Instruction.

Mann-Whitney U Test [Siegel, 1956] indicates a probability of .04 for the difference between the achieving and mildly disabled mean verbal I.Q.'s.) There is no difference between the mean performance scale I.Q.'s of the three groups. There is also no significant difference between the mean full scale I.Q.'s of the three reading groups. (The Mann-Whitney U Test indicates a probability of .10 for the difference observed between the achieving and mildly disabled mean full scale I.Q.'s.) As expected the median reading score differs significantly among the three groups. The median reading scores of the severely disabled, mildly disabled, and achieving groups are 9, 37, and 71 respectively (Table 3).

The results of the WISC scores are analyzed for reading subgroups by subtest scores in Figure 1 and Table 4. Visual examination of Figure 1 suggests an ordered relationship among the reading categories for the *Information*, *Arithmetic*, *Similarities* and *Coding* subtest means. An inverse ordered relationship exists for the *Picture Completion* subtest mean. For all other subtest means no consistent pattern is apparent.

The mean scores for each of the five ordered subtests are summarized in Table 5. On the basis of these WISC results a number of clinical decision rules are formulated for possible distribution of readers into three categories of reading ability.

This method of analyzing the data is chosen rather than a more detailed statistical analysis because of the relative simplicity and ease with which a series of decision rules can be applied to individuals. This method therefore facilitates the overlying purpose of providing a practical screening tool which can be used by persons working in the

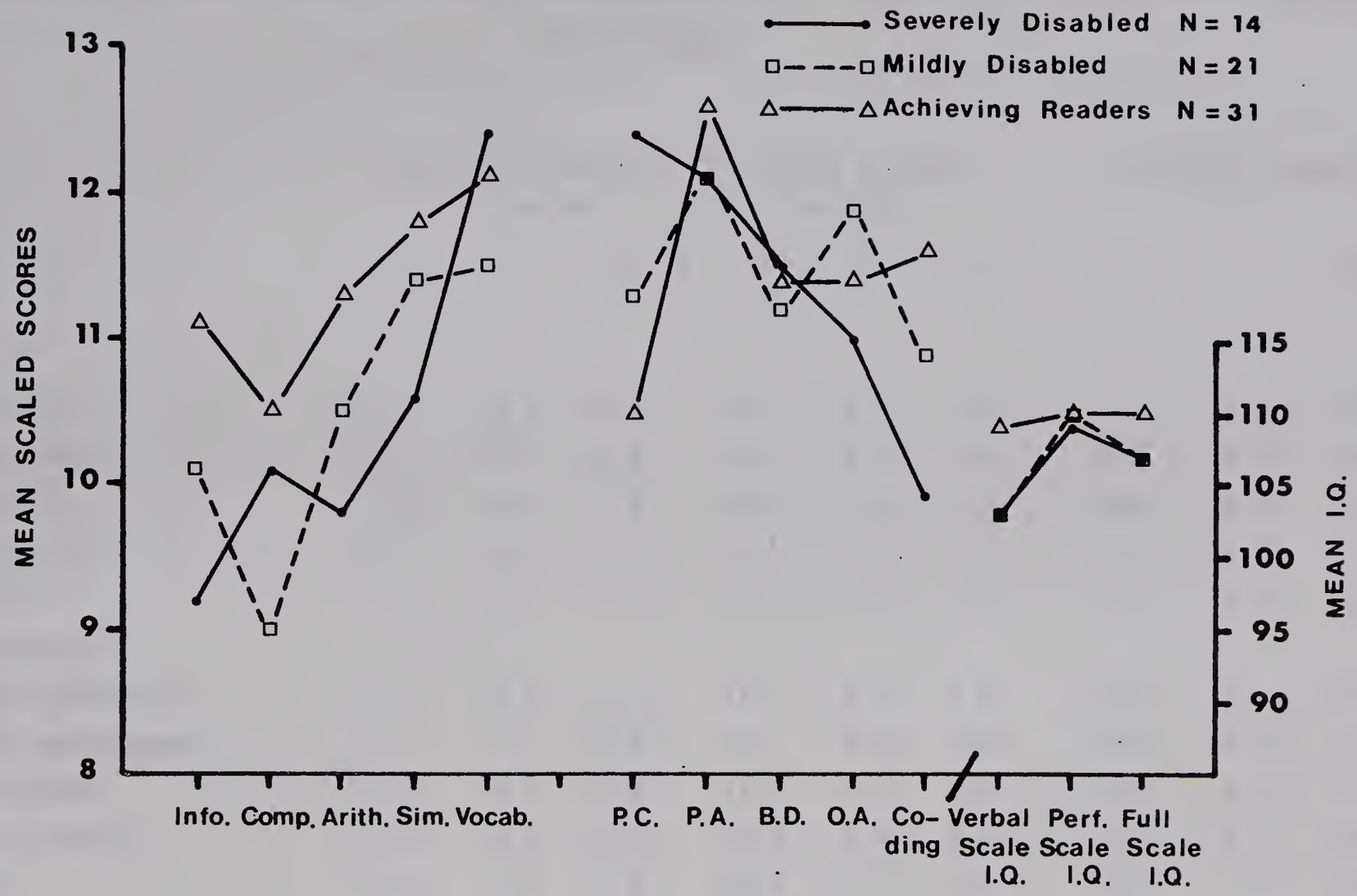

FIGURE 1. Mean WISC Subtest Scores and I.Q. Scores of Severely Disabled, Mildly Disabled and Achieving Readers.

TABLE 4. Mean WISC Subtest Scores of Severely Disabled, Mildly Disabled and Achieving Readers of the Pilot Sample

	Severely Disabled N = 14			Mildly Disabled N = 21			Achieving Readers N = 31		
	$\bar{x}$	S	$S_{\bar{x}}$	$\bar{x}$	S	$S_{\bar{x}}$	$\bar{x}$	S	$S_{\bar{x}}$
Verbal Subtests									
Information	9.2	3.3	0.9	10.1	3.1	0.7	11.1	2.2	0.4
Comprehension	10.1	3.1	0.8	9.0	2.6	0.6	10.5	2.5	0.4
Arithmetic	9.8	2.4	0.6	10.5	2.3	0.5	11.3	2.7	0.5
Similarities	10.6	3.5	0.9	11.4	2.6	0.6	11.8	2.7	0.5
Vocabulary	12.4	2.9	0.8	11.5	2.7	0.6	12.1	2.6	0.5
Performance Subtests									
Picture Completion	12.7	3.9	1.0	11.3	2.5	0.6	10.5	2.3	0.4
Picture Arrangement	12.1	1.3	0.4	12.1	2.6	0.6	12.6	2.8	0.5
Block Design	11.5	2.9	0.8	11.2	2.4	0.5	11.4	2.5	0.4
Object Assembly	11.0	2.8	0.8	11.9	3.0	0.7	11.4	2.1	0.4
Coding	9.9	1.8	0.5	10.9	2.1	0.5	11.6	1.7	0.3

TABLE 5. Summary of Ordered Subtest Means, Composite Products and Composite Subtest Scores

Subtest	Severely Disabled Readers N = 14	Mildly Disabled Readers N = 21	Achieving Achieving Readers N = 31
Information	9.2 ± 0.9	10.1 ± 0.7	11.1 ± 0.4
Arithmetic	9.8 ± 0.6	10.5 ± 0.5	11.3 ± 0.5
Similarities	10.6 ± 0.9	11.4 ± 0.6	11.8 ± 0.5
Coding	9.9 ± 0.5	10.9 ± 0.5	11.6 ± 0.3
Composite Product	9463	13080	17164
Picture Completion	12.7 ± 1.0	11.3 ± 0.6	10.5 ± 0.4
Sample $\bar{x}$ Composite Subtest Score	745	1158	1635
Test Range	below 877	877 - 1504	above 1504

field.

The initial basis of discrimination results in a Composite Product for each group. The Composite Product is formulated by multiplying the mean scores of four subtests (*Information*, *Arithmetic*, *Similarities* and *Coding*). The Composite Product is then multipled by the reciprocal of the mean score obtained on the *Picture Completion* subtest to obtain the sample mean Composite Subtest Score (Table 5). A product of these five subtest means is obtained rather than a summation because it seemed tenable to assume that the subtests interact with each other rather than function independently of each other. For example, by computing a product, it is possible to measure an interaction effect of a low *Coding* subtest score with a higher score in the verbal abstract expression area measured by the *Similarities* subtest. On the basis of clinical experience it has been observed that this pattern of scores, as well as other patterns, characterize poor readers.

The sample mean Composite Subtest scores provide a value around which scores for each reading category should fall. However, for practical clinical purposes, it is necessary to define a test range for each category.

The test range is obtained by computing a Composite Subtest Score one standard error above each of the subtest means of the mildly disabled group. This provides an upper limit for the mildly disabled group. The lower limit is obtained by computing a Composite Subtest score one standard error below each of the subtest means of the mildly disabled group. The range for the mildly disabled group is established as a Composite Subtest score higher than 877 and lower than 1504. While this method may allow the upper extremes of the mildly

disabled group to fall into the achieving category and the lower extremes of the group to overlap into the severely disabled category, it does provide an adequate means of discriminating subjects. Students are classified as severely disabled readers if they achieve a Composite Subtest Score less than 877. Students are classified as achieving readers if they achieve a Composite Subtest Score greater than 1504.

Two additional rules are necessary in order to positively identify those readers who are severely disabled. This category is the area in which the greatest concern as a clinician is focused. Students who score more than one standard deviation below the mean on the *Picture Completion* subtest appear to have very significant visual problems and are often severely disabled readers despite their adequate total scores. If these students have serious difficulty perceiving and noting detail in pictures, they also have difficulty in perceiving detail in letters and words. Their apparent compensation reflected in total scores and their need for help may be obscured.

The third rule necessary for discriminating severely disabled readers applies to subjects scoring a WISC full scale I.Q. in the superior range. If subjects in this range have *Information* and *Arithmetic* scaled scores significantly lower than the mean of their other scaled scores, they are classified as severely disabled readers. The *Information* and *Arithmetic* subtests measure abilities related to school tasks and if these scores are significantly lower for very intelligent children, it indicates school difficulty probably caused by a severe reading problem.

Decision Rules

The five decision rules are summarized as follows:

1) A subject is severely disabled if the product of his scaled scores of *Information*, *Arithmetic*, *Similarities* and *Coding* multiplied by the reciprocal of his scaled score of *Picture Completion* is less than 877, the highest possible test range score for classification as a severely disabled reader.

2) A subject is severely disabled if he scores significantly low on the *Picture Completion* subtest (a scaled score of 7 or less).

3) A subject is severely disabled if he scores a full scale I.Q. in the superior range (above 120) and has an *Information* and *Arithmetic* scaled score significantly lower than the mean of his other subtest scaled scores.

4) A subject is mildly disabled if the product of his scaled scores of *Information*, *Arithmetic*, *Similarities*, and *Coding* multiplied by the reciprocal of his scaled score of *Picture Completion* is greater than 877 and less than 1504.

5) A subject is classified as an achieving reader if he does not fall into any of the above categories and if the product of his scaled scores of *Information*, *Arithmetic*, *Similarities*, and *Coding* multiplied by the reciprocal of the scaled score of *Picture Completion* is greater than 1504.

The operation of these decision rules for this experimental sample (N=66) is summarized in Table 6. In the severely disabled category (N=14) as identified by the Stanford Achievement reading percentile score used, 12 individuals are classified similarly as severely disabled readers and 2 individuals are classified as mildly disabled readers,

TABLE 6. The Effectiveness of the Decision Rules in Categorizing the Pilot Sample

Classification by Decision Rules	Classification by the Stanford Achievement Score			
	Severely Disabled Readers	Mildly Disabled Readers	Achieving Readers	Total
Severely Disabled	12	7	5	24
Mildly Disabled	2	6	8	16
Achieving	0	8	18	26
Total Subjects	14	21	31	66

using the decision rules. In the mildly disabled category (N=21) as identified by the Stanford Achievement reading score used, 7 individuals are classified as severely disabled readers, 6 individuals are classified as mildly disabled readers while 8 individuals are classified as achieving readers. In the achieving reading category (N=31) as identified by the Stanford Achievement reading score used, 5 individuals are classified as severely disabled readers, 8 individuals are classified as mildly disabled readers while 18 individuals are classified as achieving readers, using the decision rules.

From a clinical viewpoint, it would seem that by using the decision rules on this sample, a total of 8 classified as mildly disabled by the Stanford would have not received reading help. But, on the other hand, a total of 13 subjects who according to Stanford Achievement Test results, did not need reading help, would have been referred for such help. However, using the decision rules as the only basis of discrimination, 45 subjects of the total sample of 66 would have been handled similarly with either test as an indicator.

The conclusion is that the decision rules facilitated discrimination of reading ability within the pilot sample and could have substituted for the Stanford Achievement Test scores in actual decisions made and, if anything, differentiated a larger number of boys with reading problems. However, as the decision rules were derived from the data of the pilot sample, an experimental evaluation of the validity of these rules is necessary. Therefore the validity of the decision rules will be further tested by direct application to a similar independent sample.

CHAPTER IV

TESTING THE DECISION RULES

Independent Sample

A sample (N=30), independent of the pilot study, was selected from Grade 2 and 3 boys in the same two schools of the Edmonton Public School System. The total population of Grade 2 and 3 boys in these schools was 132. As before, systematic sampling was done by selecting from an alphabetical listing within each grade level every second boy from the total school list of Grade 2 and 3 boys in each of the two schools. Care was taken in the selection procedure to not include the subjects used in the pilot study, and to select subjects for whom the Stanford Achievement Test results were available.

Tests Applied

The two tests applied were the WISC and two subtests of the Stanford Achievement Test as previously described. Initially each student was administered the WISC and, as in the pilot study, five verbal and five performance subtests were scored. The two Stanford Achievement Test percentile scores were also available for each subject from the cumulative records. The two subtests used were Word Meaning and Paragraph Meaning on the Primary II Battery administered to Grade 3 students and Word Reading and Paragraph Meaning on the Primary I Battery administered to Grade 2 students.

Performance of the Decision Rules

The sample (N=30) was classified into three categories of reading ability based on the WISC decision rules. This distribution resulted in 14 severely disabled readers, 7 mildly disabled readers and 9 achieving readers.

The operation of these decision rules as compared to a classification of the same subjects by the Stanford Achievement subtests is summarized in Table 7. As can be seen from the table, nine of the severely disabled subjects are classified similarly by the Stanford Achievement percentile scores. Three students classified as severely disabled by the decision rules are mildly disabled on the Stanford Achievement reading scores. Two students classified as severely disabled by the decision rules are achieving readers on the Stanford Achievement reading scores. Seven students classified as mildly disabled by the decision rules are achieving readers on the Stanford Achievement reading scores. One student classified as an achieving reader by the decision rules is a mildly disabled reader on the Stanford Achievement reading scores. Eight of the achieving readers are classified similarly by the Stanford Achievement percentile scores.

Using the decision rules developed it is possible to stratify 20 of the 30 subjects into the same grouping as would be attained utilizing the Stanford Achievement reading scores. From a clinical viewpoint, nine of the severely disabled readers are identified by both measures and an additional five students not so classified by the Stanford Achievement scores are identified as severely disabled by the decision rules. It would seem that the method outlined by the decision rules is a stricter measure of reading ability than the two subtests of the

TABLE 7. The Effectiveness of the Decision Rules in Categorizing the Independent Sample

Classification by Decision Rules	Classification by the Stanford Achievement Score			
	Severely Disabled Readers	Mildly Disabled Readers	Achieving Readers	Total
Severely Disabled	9	3	2	14
Mildly Disabled	0	0	7	7
Achieving	0	1	8	9
Total Subjects	9	4	17	30

Stanford Achievement Test.

The results of the validation sample are more discriminating than the results of the pilot study. Only one student classified as an achieving reader by the decision rules is mildly disabled by the Stanford Achievement Test scores. However the decision rules appear more accurate in this case as this subject's teacher reports that he experiences no difficulty in reading based on her estimation and her own teaching program.

In terms of the total validation sample, there are some differences from the sample used in the pilot study. These results are summarized in Table 8. There are no practical differences in age or grade level between the pilot and validation sample. Similarly there are no important differences between the WISC Full Scale I.Q., verbal scale I.Q., and performance scale I.Q. of the pilot sample and the validation sample although the performance scale I.Q. may be somewhat higher for the validation sample. However, the median reading scores for the validation sample are all higher than the median reading scores for the pilot study. The only scores which are closely comparable are the median scores on the Paragraph Meaning subtest. The median Word Meaning score is 23.5 percentile points higher for the validation sample. From these results it is apparent that subjects in the validation sample are better readers as measured by the Stanford Achievement Test.

The application of the decision rules to the subjects in the independent sample resulted in three reading groups summarized in Table 9.

The mean age and grade level do not differ to any great extent between the three groups. The mean WISC I.Q.'s evidence an ordered

TABLE 8. Mean Age, Grade, WISC I.Q.'s and Median Reading Scores of the Independent Sample

	$\bar{x}$	S
Age (months)	100.6	8.4
Grade	2.5	0.5
WISC I.Q.[a]		
Full Scale I.Q.	109.8	10.7
Verbal Scale I.Q.	103.3	12.2
Performance Scale I.Q.	115.2	10.5
	Median	Interquartile Range
Reading Score[b]		
Word Meaning	71	32.5
Paragraph Meaning	52.5	31
Median Score	62.5	31

[a]WISC scores have a mean of 100 and a S of 10 (Wechsler, 1949).

[b]Reading scores are given as percentile scores determined using norms of the Edmonton Public School Board, Research Department and Instruction.

TABLE 9. Mean Age, Grade, WISC I.Q.'s and Median Reading Scores of the Severely Disabled, Mildly Disabled and Achieving Readers Grouped by the Decision Rules Applied to the Independent Sample

	Severely Disabled N = 14		Mildly Disabled N = 7		Achieving Readers N = 9	
	$\bar{x}$	S	$\bar{x}$	S	$\bar{x}$	S
Age	100.3	10.1	100.0	6.5	101.4	6.7
Grade	2.4	0.5	2.6	0.5	2.8	0.4
WISC Full Scale I.Q.	101.1	7.4	115.6	7.2	118.8	5.4
Verbal Scale I.Q.	92.4	6.7	109.7	5.9	115.4	6.0
Performance Scale I.Q.	110.8	10.3	118.9	10.8	119.1	7.3
	Median	Interquartile Range	Median	Interquartile Range	Median	Interquartile Range
Reading Score						
Word Meaning	10	19.5	75	20.6	75	4.3
Paragraph Meaning	13.5	13.3	68	13.6	78	15
Median Score	14.5	18.3	74	9.5	79	9.5

relationship as reading level increases. This effect, however, is built into the decision rules in that four of the ten WISC subtests evidence this progression in scaled scores.

The mean performance I.Q. of the severely disabled group is 18 points higher than the mean verbal I.Q. of this group. The verbal and performance I.Q. differences are not as pronounced for the other two reading categories.

Classification of the independent sample by the WISC decision rules results in the segregation of individuals into only two grossly different groups as the mildly disabled and achieving groups have similar Stanford median scores (74 and 79, respectively). The median reading score of the severely disabled group is 14.5.

The mean scores for each of the five relevant subtests are summarized in Table 10. As can be seen from these means, a similar ordered relationship among the three reading categories exists for the *Information*, *Arithmetic*, *Similarities*, and *Coding* subtest means. The inverse relationship for the *Picture Completion* subtest does not appear. However the failure of the inverse relationship to appear does not prevent the successful application of the decision rules to the sample.

In addition, the decision rules were applied to 10 students already in attendance in the Resource Room. These students were referred to the Resource Room early in the year and the WISC was not administered until a month after they had been receiving resource room help. According to the Stanford Achievement Test results, seven of these students have median percentile scores in the severely disabled range and three are in the mildly disabled range.

TABLE 10. Mean Ordered WISC Subtest Scores of Severely Disabled, Mildly Disabled, and Achieving Readers Grouped by the Decision Rules Applied to the Independent Sample

	Severely Disabled N = 14		Mildly Disabled N = 7		Achieving N = 9	
Category	$\bar{x}$	S	$\bar{x}$	S	$\bar{x}$	S
Verbal Subtests						
Information	8.2	1.8	10.6	0.9	11.7	1.8
Arithmetic	8.3	2.3	9.3	1.6	12.7	2.2
Similarities	9.3	1.9	12.6	1.4	14.4	1.3
Performance Subtests						
Picture Completion	11.1	2.6	12.7	3.0	12.2	2.5
Coding	10.2	3.0	12.0	1.1	12.1	2.4

When the decision rules are applied to these students, six are classified as severely disabled and four are classified as mildly disabled readers. A summary of these ten students is presented in Table 11. From an examination of these results 4 students classified as severely disabled readers by the Stanford Achievement are mildly disabled using the decision rules. Additionally, three students classed as mildly disabled on the Stanford Achievement are severely disabled using the decision rules. It is apparent that by use of the WISC decision rules, these students would have been referred for reading help.

In summary, the conclusions stated on the basis of the pilot sample are further supported by the results of the independent sample.

TABLE 11. The Effectiveness of the Decision Rules in Categorizing Individuals Selected from the Resource Room

Classification by Decision Rules	Classification by the Stanford Achievement Score			
	Severely Disabled Readers	Mildly Disabled Readers	Achieving Readers	Total
Severely Disabled	3	3	0	6
Mildly Disabled	4	0	0	4
Achieving	0	0	0	0
Total Subjects	7	3	0	10

CHAPTER V

DISCUSSION

Differences and Similarities between the Present Study and Previous Research

The WISC decision rules formulated on the basis of the pilot study support many of the findings of other researchers. For example, Altus (1956) observed a lower score on the *Arithmetic*, *Coding* and *Information* subtests as well as a higher score on the *Picture Completion* subtest for severely disabled readers. More recent results reported by Reid and Schoer (1966) support the observation that the *Arithmetic* and *Similarities* subtest scores are low for disabled readers as well as the higher score on the *Picture Completion* subtest. However, these authors do not support the observations of lower scores on the *Information* and *Coding* subtests. The results of Hirst (1960) also offer some support in reporting that disabled readers have a high *Picture Completion* subtest score; a low *Coding* and *Arithmetic* subtest score with the possibility of a low score on the *Similarities* subtest. Hirst (1960) also found a high *Picture Arrangement* subtest score and a low *Digit Span* subtest score for mildly disabled readers; for severely disabled readers a high *Object Assembly* score was obtained in addition to those listed for the mildly disabled group.

Studies by Kallos, Grabow and Guarino (1961) offer further support as these authors reported that the *Arithmetic* and *Coding* subtest scores are significantly lower than two other subtest scores. They

have also noted a low *Coding* score relative to other performance scores. The observations of these authors differed from the results of the present study in reporting a *Block Design* score significantly higher than six other subtests. Robeck (1964) found that poor readers were significantly high on *Comprehension*, *Similarities*, *Vocabulary*, *Picture Completion* and *Block Design* subtests, and significantly low on *Information*, *Arithmetic*, *Digit Span* and *Coding* subtests. These findings offer some support to the present study although they directly contradict observations on the significantly high *Similarities* subtest score. Graham (1952) has reported a low score on *Arithmetic* and *Coding* subtests, an observation which supports the present findings. This study also reports a low score on the *Vocabulary* subtest and, in direct contradiction to the present study, a high score on the *Similarities* subtest. In agreement with the present study, Neville (1961) has reported a significantly low score on the *Information*, *Arithmetic* and *Digit Span* subtests. This author also reports a significantly high score for disabled readers on the *Picture Arrangement* and *Block Design* subtests, an observation not found in the present study. Burks and Bruce (1955) report a low score on *Information*, *Arithmetic* and *Coding* subtests and a high score on *Picture Arrangement*, *Block Design* and *Comprehension* subtests. These findings offer partial support for the present study.

Ackerman, Peters, and Dykman (1971) have found that an achieving reader has a verbal scale I.Q. fifteen or more scaled points higher than the performance scale I.Q. Poor readers were reported to have a performance scale I.Q. fifteen or more points higher than the verbal scale I.Q. The results of the pilot study offer no support for these

findings. However, the results of the validation sample support this finding in that the mean performance I.Q. for the severely disabled group is eighteen points higher than the mean verbal I.Q. The same relationship does not hold for the mildly disabled group nor does the inverse relationship reported exist for the achieving reading group.

Previous studies offer some support for the findings of the present study, although no evidence to date is completely consistent with the WISC decision rules.

Present Study

Few, if any, studies have attempted to use an interaction effect in analysing the relationship between the subtest scores. It appears reasonable though to consider a multiplicative effect because no one subtest measures completely different abilities nor is reading entirely dependent on any one ability. The causative factors that may be involved in reading retardation are numerous and are present in individuals in varying combinations and degrees. It would seem that certain essential skills need to be present before a child can learn to read. For example, an adequate meaning vocabulary is essential to reading (reviewed by Robinson, 1946). In order to secure meaning from symbols, an adequate speaking vocabulary with clear, distinct speech is usually desirable. Adams (1936) summarizes this relationship as follows:

> "Many children are plunged into reading before they have developed vocabularies to express their own ideas clearly, to say nothing of their lack of ability to understand the content to be read....Not until children have developed some ability in oral expression can they be expected to comprehend or reproduce through reading the ideas of others." (Adams, 1936).

But this ability to use language is not the only skill necessary to produce an achieving reader. Abilities such as certain perceptual skills, the ability to concentrate and the ability to remember are all important to reading skill. To say, for example, that poor readers as a group score relatively low on the *Arithmetic* subtest is to overlook the child whose performance on that subtest is adequate but whose reading problem is as severe as for a child whose *Arithmetic* score is below average. Multiplying relevant WISC subtest scores measuring these different skills appears to be a successful means of compensating for an individual's idiosyncratic profile of relevant WISC scores.

The most difficult reading group to clearly identify using the decision rules is the mildly disabled reading group. According to Stanford Achievement Test scores, this group of readers included readers who scored a large discrepancy between Word Reading and Paragraph Meaning scores. In the independent sample all but one of the subjects classified as mildly disabled by the Stanford Achievement score are classified as severely disabled subjects by the decision rules. In the pilot sample, this same effect of dissipation of the mildly disabled readers was observed, although less dramatically. It may well be argued that a student who scores below the 25th percentile on either Stanford subtest is a severely disabled reader. Skills in one area may be so depressed as to bring total reading ability down to a severely disabled level in any practical sense. For example, one student who scored at the 90th percentile in word reading and at the 2nd percentile in paragraph meaning is certainly a seriously disabled reader for any practical purposes and yet would fall into the mildly disabled category. He would be a student who would possibly escape

teacher notice and yet would need immediate and intensive remedial help in comprehension skills. The decision rules predict that students in this category do require remediation and as such a large percentage of these students fall into the seriously disabled reading category. For students in this category the decision rules provide a more stringent measure of reading disability than does the Stanford Achievement Test.

Results of the independent sample indicate that the WISC screens out the severely disabled readers and, by using the decision rules, the mildly disabled and achieving reading groups merge into one group and leave a sharply defined severely disabled group.

It would seem that the decision rules do form a successful means of discriminating boys who need remedial reading instruction at the second and third grade level.

Future Research

It would be interesting to determine if a similar means of identification by use of the WISC can be employed to screen Grade 1 students. By extending this method of reading discrimination to students at the Grade 1 level it would be possible to screen and implement remedial reading programs at an earlier stage. A longitudinal study with periodic testing beginning in Grade 1 would provide information leading to early identification of disabled readers. Such a study would also be valuable in establishing specific instructional methods designed to promote successful learning for this group.

A profitable area for future research would involve studies that explore the implications that the WISC subtests have for the reading

process itself. It would be valuable to identify tasks on the WISC similar to tasks involved in reading and, on the basis of these findings, design remedial programs for these students. For example, the *Coding* subtest measures skills related to visual motor ability and by using programs to build up these skills it should be possible to improve these skills and positively affect reading scores.

Further research into the sharp differentiation that appears between severely disabled readers and other readers when students are classified using the WISC decision rules in the independent sample results, should be pursued. If this finding is confirmed by further testing, the WISC would prove to be an even more powerful instrument in diagnosing reading problems.

An important implication from the present study is that severely disabled readers can be identified. These students seem to make little progress in overcoming their handicaps in a regular classroom. They need a different kind of learning situation and perhaps the resource room setting at an early age will provide this needed setting. The decision rules derived from this study may provide the means of discriminating these students.

Conclusions

The major conclusion drawn from these studies is that the decision rules based on WISC test results derived from the pilot study, can be used to discriminate between different reading abilities. The subtests which are most important for discrimination are the *Information*, *Arithmetic*, *Similarities*, *Picture Completion*, and *Coding* subtests. Use of the product of these subtests effectively discriminated disabled readers from achieving readers.

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